

# Taxonomy of the Crimson-winged Finch *Rhodopechys sanguineus*: a test case for defining species limits between disjunct taxa?

Guy M. Kirwan<sup>a</sup>, Phil W. Atkinson<sup>b</sup>, Arnoud B. van den Berg<sup>c</sup> and Hadoram Shirihai<sup>d</sup>

Taxonomie du Roselin à ailes rouges *Rhodopechys sanguineus*: un cas d'étude pour définir les limites des espèces entre des taxons géographiquement éloignés? Nous avons examiné la taxonomie du Roselin à ailes rouges *Rhodopechys sanguineus* en utilisant des données de la morphologie, des mensurations et des vocalisations. Cette espèce a traditionnellement été traitée comme polytypique, comprenant deux taxons, la sous-espèce nominale *sanguineus* d'Asie occidentale et centrale, et *alienus* d'Afrique du nord-ouest. Peu d'auteurs ont relevé les différences morphologiques manifestes entre les deux, quoique Fry & Keith (2004) aient récemment suggéré qu'ils puissent constituer des espèces phylogénétiques. Nos analyses indiquent que jusqu'à neuf caractéristiques de plumage séparent les mâles des deux taxons (dont quatre sont diagnostiques et plusieurs autres presque), et trois caractéristiques peuvent être utilisées de façon fiable pour distinguer les femelles (dont toutes sont entièrement ou quasiment diagnostiques). Nous décrivons également des variations du plumage saisonnières et liées à l'âge, chez les deux taxons. De plus, des données morphométriques soumises à l'Analyse en Composantes Principales indiquent que les deux taxons, et surtout les femelles, sont plutôt mieux séparés au niveau de la taille et des proportions qu'on ne le pensait jusqu'à présent. Il a été impossible de faire des comparaisons adéquates entre les vocalisations des deux taxons, peut-être parce que les enregistrements disponibles proviennent de différentes saisons, et sans doute à cause des variations individuelles considérables des cris. Bien que nos résultats exigent un examen moléculaire, utilisant particulièrement plusieurs autres membres des roselins des zones désertiques comme 'outgroup', ils suggèrent assez bien qu'il s'agit de deux allo-espèces, peut-être même deux espèces à part entière, si on se base sur la définition du rang d'espèce de Helbig *et al.* (2002). On peut trouver également une répartition biogéographique identique ou similaire (à celle des deux taxons de *Rhodopechys*) chez plusieurs autres formes qu'il semble préférable de considérer comme spécifiquement distinctes (telles que les Fauvettes naines africaine *Sylvia deserti* et asiatique *S. nana*). Nos résultats renforcent en outre l'importance—apparemment de plus en plus négligée—des spécimens conservés dans les musées pour la taxonomie aviaire, à une époque où les études moléculaires semblent avoir acquis une importance suprême (Collar 2004).

**Summary.** Using morphology, morphometrics and vocalisations we investigated the taxonomy of the Crimson-winged Finch *Rhodopechys sanguineus*, which has traditionally been viewed as a polytypic species, comprising two taxa, nominate *sanguineus* in western and Central Asia, and *alienus* in north-west Africa. Few previous commentators have remarked on the obvious morphological differences between the two, although Fry & Keith (2004) recently suggested that they might be phylogenetic species. Our analyses suggest that as many as nine plumage features separate males of the two taxa (four being diagnostic and several others nearly so), and three features can be reliably used to distinguish females (of which all are diagnostic or virtually so). We also describe seasonal and age-related plumage variation in both taxa. Furthermore, morphometric data subjected to a Principal Components Analysis suggest that the two are rather better separated in size and shape than previously thought, especially in females. It proved impossible to draw adequate comparisons between the vocalisations of the two taxa, perhaps due to the available recordings being from different seasons, and certainly because of considerable individual variation in calls. Our results demand molecular testing, using especially various other members of the 'desert finches' as an outgroup, but provide strong indication that two allospecies, perhaps even full species, are involved, based on the guidelines for assigning species rank of Helbig *et al.* (2002). The same or

a similar biogeographical pattern as found in the two *Rhodopechys* taxa is also evident in a number of other forms which seem best considered as being specifically distinct (e.g. African Desert Warbler *Sylvia deserti* and Asian Desert Warbler *S. nana*). Our results further reinforce the seemingly increasingly neglected importance of the museum skin in avian taxonomy, in an epoch where molecular studies appear to have acquired paramount importance (Collar 2004).

**C**rimson-winged Finch *Rhodopechys sanguineus* (Gould, 1838) was described from the environs of Erzurum, in north-eastern Turkey. The species is considered polytypic, with the nominate form breeding in montane areas from west-central Turkey and, very patchily, in the Levant, somewhat more continuously east to Central Asia and extreme north-west China (in Xinjiang), whilst the taxon *R. s. alienus* Whitaker, 1897, inhabits similar high-altitude areas in north-west Africa, principally in the Moroccan High Atlas, but also extremely locally in the Aurès massif of north-east Algeria (Cramp & Perrins 1994). As recently noted by Kirwan & Gregory (2005), the taxonomy of the species has rarely been discussed in the literature, with the only detailed data concerning geographical variation being those presented by Vaurie (1949) and C. S. Roselaar *in* Cramp & Perrins (1994). Even moderately detailed specialist works dealing with the carduelines have provided only relatively limited and incomplete discussions of variation within the species (e.g. Clement *et al.* 1993). Indeed, in recent years arguably more attention has focused on generic limits and phylogenetic relationships amongst the so-called 'desert finches,' i.e. Crimson-winged Finch, Desert Finch *Rhodospiza obsoleta*, Trumpeter Finch *Bucanetes githagineus* and Mongolian Finch *B. mongolicus* (Groth 1998, Kirwan & Gregory 2005), although it had been suggested that, alone of these, *R. sanguineus* is more closely related to Red-browed Finch *Callacanthis burtoni* from the Himalayas (see Desfayes 1969). Some further evidence of the latter relationship was acquired during the course of the present study, but this is one of the many problems confronting workers with Asiatic finches (see, e.g., Voous 1977) that demands further testing using molecular methods. C. S. Roselaar (*in litt.* 2006) has pointed out the morphological similarities between Crimson-winged Finch and at least one taxon of Asian Rosy Finch *Leucosticte arctoa brunneonucha*. They share a black cap, pale nape, pink rump, pink wing-fringing, dark throat

and flanks (though brown in *sanguineus* and sooty black in *brunneonucha*), and pale spots on chest (the latter especially in *alienus*). Also, they share possession of a bifurcated gular pouch, though the occurrence of this in fringillids other than *Pinicola* and *Pyrrhula* is poorly documented (see Niethammer 1966). It might also be remarked that some of the North American forms of rosy finches share almost as many morphological characters with Crimson-winged Finch. The important work of Groth (1998 and in progress) thus far suggests, amongst many other results, that Desert Finch occupies a clade containing the many canaries, some *Carduelis* and Golden-winged Grosbeak *Rhynchostruthus socotranus*; *Callacanthis* clusters with the mountain finches *Leucosticte*, *Carpodacus nipalensis* and *Pyrrhopterus epauleta*; and that Crimson-winged Finch and Mongolian Finch form a separate clade.

Roselaar (*op. cit.*) considered geographical variation in Crimson-winged Finch to be 'fairly strong,' albeit involving colour alone, and, whilst this study was in progress, Fry & Keith (2004) noted that *Rhodopechys sanguineus alienus* might represent a phylogenetic species, although strangely the illustrations in the same work appear to show characteristics of nominate *sanguineus*! The purpose of the present contribution is to draw attention to the larger differences that exist between *R. s. sanguineus* and *R. s. alienus* than have heretofore been suspected. (Throughout we follow David & Gosselin 2002 for spellings of the various taxa in the 'desert finches.')

## Methods

GMK acquired mensural data from specimens of both relevant taxa (see Table 1), and all others within the desert finches grouping, held at the Natural History Museum (NHM, Tring), as follows: *Callacanthis burtoni* (Punjab and north-west India:  $n=17$ , including nine males); *Rhodopechys sanguineus* (Armenia, Syria, Iran, Turkey, Lebanon, Kazakhstan and Samarkand:  $n=30$ , including 22 males); *R. s. alienus* (Moroccan Atlas:



**Table 1.** Means  $\pm$  SD and sample sizes for wing, tail and bill measurements of the 'desert finches,' based on specimens held in The Natural History Museum (Tring). Any specimen for which one dataset or more could not be measured was excluded from the analysis and table.

**Tableau 1.** Moyenne  $\pm$  SD et nombre d'échantillons pour les mensurations de l'aile, la queue et le bec des rosélins des zones désertiques, basés sur des spécimens du Natural History Museum (Tring). Tout spécimen pour lequel un ou plusieurs ensembles de données ne pouvaient pas être mesurés a été exclu de l'analyse et du tableau.

BGG = *Bucanetes githagineus githagineus*, BGA = *B. g. amantum*, BGC = *B. g. crassirostris*, BGZ = *B. g. zedlitzi*, BM = *B. mongolicus*, CB = *Callacanthus burtoni*, RO = *Rhodospiza obsoleta*, RS = *Rhodopechys sanguineus sanguineus*, RSA = *R. s. alienus*.

	Females				Males			
	Wing (mm)	Tail (mm)	Bill (mm)	N	Wing (mm)	Tail (mm)	Bill (mm)	N
BGG	79.33 $\pm$ 1.15	50.33 $\pm$ 0.58	10.23 $\pm$ 0.81	3	83.33 $\pm$ 2.67	51.58 $\pm$ 2.39	10.31 $\pm$ 0.43	12
BGA	80.14 $\pm$ 2.34	51.14 $\pm$ 2.04	10.87 $\pm$ 0.31	7	82.43 $\pm$ 1.51	53.14 $\pm$ 2.27	10.79 $\pm$ 0.52	7
BGC	83.6 $\pm$ 2.88	54.4 $\pm$ 2.63	10.41 $\pm$ 0.47	10	87.18 $\pm$ 2.32	57.27 $\pm$ 4.13	10.80 $\pm$ 0.28	11
BGZ	83.67 $\pm$ 1.53	54.00 $\pm$ 1.00	10.50 $\pm$ 0.46	3	85.75 $\pm$ 1.59	54.65 $\pm$ 3.23	10.47 $\pm$ 0.31	20
BM	86.94 $\pm$ 1.69	55.75 $\pm$ 3.71	10.17 $\pm$ 0.59	16	88.77 $\pm$ 1.88	56.65 $\pm$ 3.14	10.07 $\pm$ 0.52	26
CB	94.44 $\pm$ 1.24	64.50 $\pm$ 3.89	15.25 $\pm$ 0.84	8	98.94 $\pm$ 1.84	67.11 $\pm$ 3.18	15.38 $\pm$ 0.46	9
RO	84.13 $\pm$ 1.64	64.25 $\pm$ 3.81	11.66 $\pm$ 0.46	8	86.36 $\pm$ 1.91	64.21 $\pm$ 3.62	11.79 $\pm$ 0.58	14
RS	<b>99.38 <math>\pm</math> 1.85</b>	<b>56.63 <math>\pm</math> 2.56</b>	<b>13.64 <math>\pm</math> 0.92</b>	<b>8</b>	<b>104.05 <math>\pm</math> 2.59</b>	<b>60.26 <math>\pm</math> 3.26</b>	<b>13.76 <math>\pm</math> 0.65</b>	<b>19</b>
RSA	<b>102 <math>\pm</math> 1.87</b>	<b>61.40 <math>\pm</math> 1.14</b>	<b>13.60 <math>\pm</math> 0.43</b>	<b>5</b>	<b>105.57 <math>\pm</math> 2.76</b>	<b>64.00 <math>\pm</math> 1.15</b>	<b>13.30 <math>\pm</math> 0.4</b>	<b>7</b>

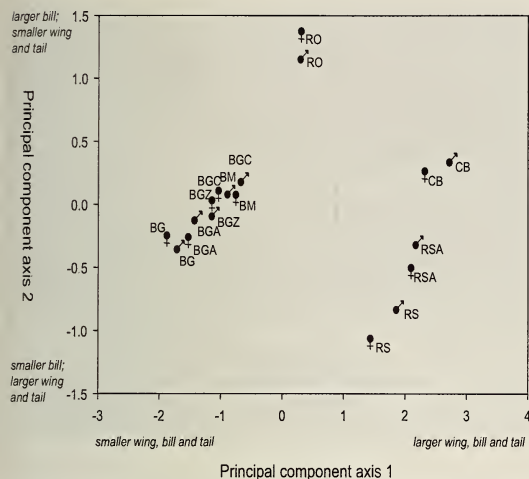
$n=13$ , including seven males); *Bucanetes mongolicus* (China, Central Asia and Afghanistan:  $n=44$ , including 27 males); *B. g. githagineus* (all Egypt:  $n=15$ , including 12 males); *B. g. zedlitzi* (Morocco, Algeria and Tunisia:  $n=24$ , including 20 males); *B. g. amantum* (Canaries:  $n=16$ , including eight males); *B. g. crassirostris* (Punjab and Sind:  $n=21$ , including 11 males); and *Rhodospiza obsoleta* (Central Asia:  $n=22$ , including 14 males). Specimens were generally sexed according to label data, but these were checked closely against relevant literature (Svensson 1992, Cramp & Perrins 1994) and work in progress (Shirihai & Svensson in prep.) in the case of suspect identifications. The following data were obtained from each specimen: wing (flattened), tail-length and culmen-length (to base of feathers), using a standard metal wing-rule with a perpendicular stop at zero (accurate to 0.5 mm), and dial callipers (accurate to 0.1 mm). Specimens for which an incomplete series of mensural data was available were excluded from the statistical analysis.

Notes on plumage variation in both sexes of the two forms of Crimson-winged Finch were taken and, following comparison with those features listed as separating nominate *sanguineus* and *alienus* by Roselaar (*op. cit.*), were ranked according to their usefulness in distinguishing the two. None of the features discussed by Roselaar was found to be invalid, but there was a clear hierarchy in their relative usefulness. Thus, they were arbitrarily graded as being either average or good, with

the latter category being further subdivided into good- and good+ (these subdivisions can be considered as being 'virtually diagnostic' and 'diagnostic'). A broad range of material, pertaining to both forms, was photographed, using a Nikon Coolpix 885 digital camera, in indirect natural light (see Figs. 3–10).

## Results

*Mensural data.*—A Principal Components Analysis (PCA) was performed on the net mensural data and the results mapped on both two-dimensional (Fig. 1) and three-dimensional plots (Fig. 2). The two-dimensional plot confirmed that (as is well known for these taxa) males are generally larger than females, and further revealed that *Rhodospiza obsoleta*, *Callacanthus burtoni*, *Rhodopechys sanguineus* and *R. s. alienus* are all rather well-differentiated taxa, with the two-dimensional plot also revealing the close relationship that has been suggested between *Callacanthus* and *Rhodopechys*. Plotted three-dimensionally, the degree of separation between *R. s. sanguineus* and *R. s. alienus* is particularly clear, and is rather larger than that between most other subspecies studied within this group of finches. As is evident from Table 1, both sexes of *alienus* tend to be longer winged and longer tailed than the same sexes of *sanguineus*, with particularly little overlap in females (perhaps influenced by the smaller sample sizes). Culmen-length appears very similar in the two taxa.

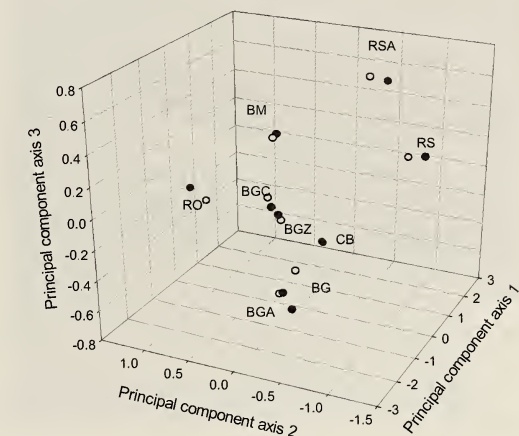


**Figure 1.** Results of a Principal Components Analysis for wing-, tail- and bill- (culmen-) lengths of all taxa of 'desert finches' plotted two-dimensionally.

Résultats d'une Analyse en Composantes Principales pour la longueur de l'aile, la queue et le bec (culmen) de l'ensemble des taxons des rosélins des zones désertiques indiqués de façon bi-dimensionnelle.

BGG = *Bucanetes githagineus githagineus* (12 ♂♂, 3 ♀♀), BGA = *B. g. amantum* (7 ♂♂, 7 ♀♀), BGC = *B. g. crassirostris* (11 ♂♂, 10 ♀♀), BGZ = *B. g. zedlitzi* (20 ♂♂, 3 ♀♀), BM = *B. mongolicus* (26 ♂♂, 16 ♀♀), CB = *Callacanthus burtoni* (9 ♂♂, 8 ♀♀), RO = *Rhodospiza obsoleta* (14 ♂♂, 8 ♀♀), RS = *Rhodopechys sanguineus sanguineus* (19 ♂♂, 8 ♀♀), and RSA = *R. s. alienus* (7 ♂♂, 5 ♀♀)

**Plumage.**—As detailed in Table 2, nine features are useful for separating males of the two taxa, of which the majority are better than average and four are ranked as extremely good (i.e. diagnostic). Fewer features, just three, separate females of *alienus* from *sanguineus*, but all are diagnostic or virtually so (Table 3). As noted by Vaurie (1949), Roselaar in Cramp & Perrins (1994), and Roselaar (1995), there is no evidence of geographical variation in either plumage or size within Asian populations of *R. s. sanguineus*, although Vaurie (1949) thought that Azerbaijani birds might tend to have a slightly longer tail. We have not examined any specimens from Algeria and are thus unable to comment as to the presence (or not) of any variation within *alienus*, although Clement *et al.* (1993) erroneously suggested that the species might only be a winter visitor to this region. In fact, as noted by Isenmann & Moali (2000), there



**Figure 2.** Results of a Principal Components Analysis for wing-, tail- and bill- (culmen) lengths of all taxa of 'desert finches' plotted three-dimensionally. Axis 1 and 2 are correlated as in Fig. 1, whilst axis 3 is positively correlated with wing and tail and negatively correlated with bill.

Résultats d'une Analyse en Composantes Principales pour la longueur de l'aile, la queue et le bec (culmen) de l'ensemble des taxons des rosélins des zones désertiques indiqués de façon tri-dimensionnelle. Les axes 1 et 2 sont corrélés comme dans la Fig. 1, tandis que l'axe 3 est corrélié positivement avec l'aile et la queue et négativement avec le bec.

BGG = *Bucanetes githagineus githagineus* (12 ♂♂, 3 ♀♀), BGA = *B. g. amantum* (7 ♂♂, 7 ♀♀), BGC = *B. g. crassirostris* (11 ♂♂, 10 ♀♀), BGZ = *B. g. zedlitzi* (20 ♂♂, 3 ♀♀), BM = *B. mongolicus* (26 ♂♂, 16 ♀♀), CB = *Callacanthus burtoni* (9 ♂♂, 8 ♀♀), RO = *Rhodospiza obsoleta* (14 ♂♂, 8 ♀♀), RS = *Rhodopechys sanguineus sanguineus* (19 ♂♂, 8 ♀♀), and RSA = *R. s. alienus* (7 ♂♂, 5 ♀♀).

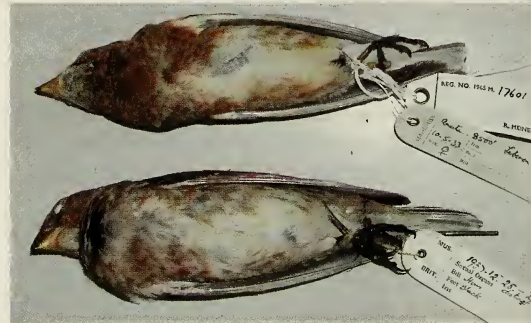
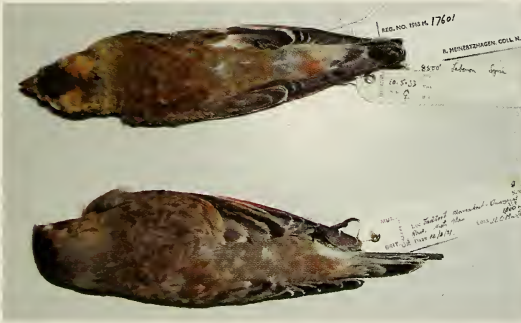
is at least one summer (July) record of birds in suitable breeding habitat.

**Vocalisations.**—The vocal analysis was performed by AvdB and Magnus Robb. Approximately 30 recordings belonging to the two taxa, from Morocco, Turkey and Georgia, and archived in The Sound Approach, UK / Netherlands, database, were included in the comparison. Individual variation proved to be considerable, to the point where any real differences between the two are obscured. Like several other carduelines, it seems that individual pairs may produce their own variants of certain calls, at least during the breeding season. Furthermore, the available recordings of

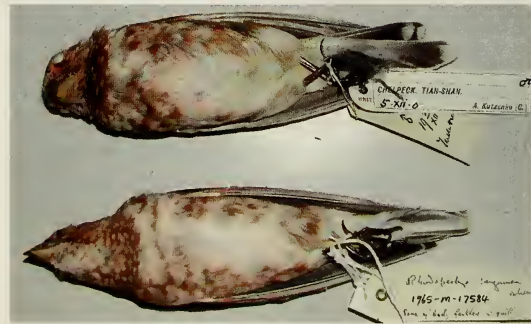




Figures 3–4. Dorsal and ventral views of the same specimens of adult males of *Rhodopechys sanguineus sanguineus* (upper) and *R. s. alienus* (lower) in worn (spring) plumage (Guy M. Kirwan, © The Natural History Museum, Tring)  
 Vues dorsales et ventrales des mêmes spécimens de mâles adultes de *Rhodopechys sanguineus sanguineus* (en haut) and *R. s. alienus* (en bas) en plumage usé (printemps) (Guy M. Kirwan, © The Natural History Museum, Tring)



Figures 5–6. Dorsal and ventral views of the same specimens of adult females of *Rhodopechys sanguineus sanguineus* (upper) and *R. s. alienus* (lower) in worn (spring) plumage (Guy M. Kirwan, © The Natural History Museum, Tring)  
 Vues dorsales et ventrales des mêmes spécimens de femelles adultes de *Rhodopechys sanguineus sanguineus* (en haut) and *R. s. alienus* (en bas) en plumage usé (printemps) (Guy M. Kirwan, © The Natural History Museum, Tring)



Figures 7–8. Dorsal and ventral views of the same specimens of adult males of *Rhodopechys sanguineus sanguineus* (upper) and *R. s. alienus* (lower) in fresh (autumn) plumage (Guy M. Kirwan, © The Natural History Museum, Tring)  
 Vues dorsales et ventrales des mêmes spécimens de mâles adultes de *Rhodopechys sanguineus sanguineus* (en haut) and *R. s. alienus* (en bas) en plumage frais (automne) (Guy M. Kirwan, © The Natural History Museum, Tring)



Figures 9–10. Dorsal and ventral views of the same specimens of first-summer males of *Rhodopechys sanguineus sanguineus* (upper three) and *R. s. alienus* (lower bird) showing inter- and intra-taxon variation (Guy M. Kirwan, © The Natural History Museum, Tring)

Vues dorsales et ventrales des mêmes spécimens de mâles de 1er été de *Rhodopechys sanguineus sanguineus* (les trois d'en haut) and *R. s. alienus* (l'oiseau du bas) illustrant les variations inter- et intra-taxons (Guy M. Kirwan, © The Natural History Museum, Tring)



Figures 11–12. Male *Rhodopechys sanguineus alienus*, Oukaimeden, Morocco, 5 April 2005 (Arnoud B. van den Berg)  
*Rhodopechys sanguineus alienus*, mâle, Oukaimeden, Maroc, 5 avril 2005 (Arnoud B. van den Berg)

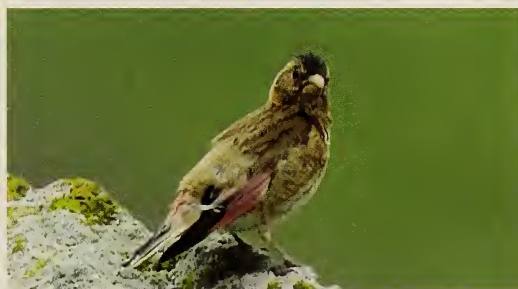


Figure 13. Female *Rhodopechys sanguineus alienus*, Oukaimeden, Morocco, 5 April 2005 (Arnoud B. van den Berg)  
*Rhodopechys sanguineus alienus*, femelle, Oukaimeden, Maroc, 5 avril 2005 (Arnoud B. van den Berg)

Figure 14. Male *Rhodopechys sanguineus sanguineus*, Kazbegi, Georgia, 22 June 2005 (René Pop)  
*Rhodopechys sanguineus alienus*, mâle, Kazbegi, Georgie, 22 juin 2005 (René Pop)



**Table 2.** Relative hierarchy in those features listed by Roselaar (*in* Cramp & Perrins 1994) as useful for separating males of *Rhodopechys sanguineus sanguineus* and *R. s. alienus*, on the basis of specimen examination of material held in The Natural History Museum (Tring).

**Tableau 2.** Hiérarchie relative des caractéristiques mentionnées par Roselaar (en Cramp & Perrins 1994) comme étant utiles pour séparer les mâles de *Rhodopechys sanguineus sanguineus* et de *R. s. alienus*, sur la base de l'examen de spécimens conservés au Natural History Museum (Tring).

Feature	Ranking	Comments
<i>R. s. alienus</i> has only very indistinct black on mantle	good+	
<i>R. s. alienus</i> lacks pink in uppertail-coverts	good+	as noted by Roselaar, there may be a vinous wash in fresh plumage
<i>R. s. alienus</i> lacks black spotting on ear-coverts and breast	good+	see also comment below*
<i>R. s. alienus</i> has central chin and throat grey-white tinged rosy, with narrow brown upper-breast-band	good+	nominate has throat more or less concolorous with breast, and the brown markings on lower breast/belly and flanks are more extensive than in <i>alienus</i>
<i>R. s. alienus</i> has tail more extensively dark (less black) on outer feathers	good-	
<i>R. s. alienus</i> has less red on the flight-feathers	good-	entire wing seems to show less pink and white elements, but there is some overlap with the nominate
<i>R. s. alienus</i> has less red on face and none on fore supercilium	average/ good	some have fore supercilium marked with red (e.g. NHM 1937.12.28.27)
<i>R. s. alienus</i> has black of crown more restricted to fore part	average	
<i>R. s. alienus</i> lacks rufous on back, mantle and head-sides	average	this feature is not always apparent in <i>R. s. sanguineus</i>

\*Very worn *R. s. sanguineus* can show quite some pink on the underparts, but *R. s. alienus* never shows such coloration (e.g. NHM 1949.Whistler.8802).

*alienus* were made at a different stage of the breeding season to those of nominate *sanguineus*. Further work on this issue would be interesting to perform, nonetheless, especially to record and compare the vocalisations of the two in winter, when their repertoires are presumably less extensive and flock/species cohesion is more important than pair cohesion or individual advertisement. Even so, even if clear-cut differences did become evident as the result of such fresh analysis, this would not necessarily serve as anything other than interesting additional support for regarding the two taxa as species. Furthermore, we have not conducted playback experiments to ascertain any measure of responsiveness of one taxon to the song of the other. In any case, we note that 'such tests do not provide conclusive proof one way or the other' (Helbig *et al.* 2002).

### Age-related and seasonal plumage variation

Based on examination of specimen material at NHM we present the following notes on plumage

variation, both age-related and seasonal. For further details see Shirihai & Svensson (*in prep.*), and also Figs. 3–10.

#### *R. s. sanguineus*

Sexes moderately differentiated, mainly in spring/summer, otherwise seasonal plumage variation rather limited and mostly due to wear. Post-breeding moult (complete) and post-juvenile (partial) moult chiefly in August–September, but pre-breeding moult (adult and first-year) is apparently absent. **SPRING Worn. Adult ♂** Wear increases contrast of uniform black cap, face pattern (especially pale supercilium and collar), rose tone to lower back/rump and red at bill base, on lores and around eye; also breast and breast-sides more rufous-cinnamon and black-spotted central breast and flanks, and red basal areas on wings and tail are more conspicuous, but (in both sexes) white tips to remiges virtually wear off. A few also develop a slightly pale pinkish cream-brown throat but not to the same extent as some first-summer ♂♂. Bill changes from greyish to dull warm yellow

**Table 3.** Relative hierarchy in those features listed by Roselaar (*in Cramp & Perrins 1994*) as useful for separating females of *Rhodopechys sanguineus sanguineus* and *R. s. alienus*, on the basis of specimen examination of material held in The Natural History Museum (Tring).

**Tableau 3.** Hiérarchie relative des caractéristiques mentionnées par Roselaar (*en Cramp & Perrins 1994*) comme étant utiles pour séparer les femelles de *Rhodopechys sanguineus sanguineus* et de *R. s. alienus*, sur la base de l'examen de spécimens conservés au Natural History Museum (Tring).

Feature	Ranked	Comments
Throat and breast pattern is as male and differs from nominate	good+	female <i>R. s. alienus</i> has some pale spots in breast-band and ear-coverts, whereas female <i>R. s. sanguineus</i> has more tawny-brown on flanks and lower breast-sides, and has solid tawny-brown ear-coverts, breast and throat, whilst some even show a slightly pink fore-face (never shown by <i>alienus</i> )
<i>R. s. alienus</i> has less black in crown	good-	
<i>R. s. alienus</i> has upperparts greyer and rump less pink/white	good-	

when breeding. In the hand, r5 white, except broad but incomplete dark subterminal field on inner web (concentrated on outer part) and almost entirely dark outer web, whilst r6 is white, except usually for the black shaft and, occasionally, a diffuse and narrow dark area on the edge of the inner web. **Adult** ♀ Duller than ♂, with paler crown patch, reduced capped appearance, more white and duller pink in wings and virtually no pink in tail, and has whiter, less rufous and less spotted underparts (some have chin and throat cream white). The central remiges and primary-coverts, especially, are more narrowly fringed paler pink-red (with browner and less obvious centres); r5 white as in ♂ but has broader and more complete black subterminal field, and r6 has broader and darker area along edge of inner web and at tip, not uniform white. Mantle and scapulars browner and much less heavily streaked, and lower back to uppertail-coverts paler grey-brown, tinged isabelline, whilst lores and eye surround greyish cinnamon-buff (usually almost no red), with paler ear-coverts and less contrasting supercilium. Bill greyish-horn (much less yellow). **First-summer** Very like respective adults and best aged by retained juvenile wing- and tail-feathers, with moult limits as first-winter, but even more contrastingly worn, and extent of subterminal black areas in r5–6 as latter. Much individual variation, especially in ♂♂, with some approaching adult ♀ in overall coloration (but usually safely sexed using same criteria as for adults). Some have, to a varying degree, a white throat and upper breast with almost unstreaked breast and flanks, and thus approach *R. s. alienus*. **AUTUMN** Fresh. **Adult** ♂

Black crown patch is narrowly fringed cinnamon-buff whilst carmine-red of face is duller, upperparts more buff/rufous-brown, less heavily streaked but broadly fringed, and rump/uppertail-coverts tinged pale rosy-pink, although often concealed. Whitish band between breast and flanks and upper belly washed pale pink, with yellowish-buff breast and flanks tipped whitish and unstreaked or virtually so. **Adult** ♀ Much as spring, but broad greyish-buff fringes to crown, upperparts and upperwings, and plumage even duller. In both sexes pale fringes to wing- and tail-feathers are broader, with carmine-pink and red basal area partially concealed (thus overall wing pattern less contrasting than in spring). Both sexes differ from first-winter in being evenly fresh, with broader and whiter primary tips. **First-winter** (both sexes following post-juvenile renewal of head, body, lesser and median coverts, perhaps some inner greater coverts and tertials, and a few apparently replace even some inner primaries, primary-coverts, secondaries and r1.) ♂ has overall plumage like fresh adult ♂ but strongly approaches ♀, thus sexual dimorphism obscured. Adult head and underparts patterns strongly reduced and have more extensive pale flecks (chin/throat variable), upperparts essentially warm brown and paler rump than adult. Pink and white areas in remiges and rectrices also generally duller or reduced. Retained juvenile greater coverts have blackish-brown inner web and brown-buff on most of outer web, except narrow pink fringe; the retained primary-coverts are mostly dull brown with narrow fringes. Tail has more extensive dark areas than in adult ♂, and pattern approaches



adult ♀. **First-winter** ♀ Much like first-winter ♂, but plumage paler with generally much-reduced pink in wing and fringes to greater coverts mainly buff with limited or no pink; terminal half of r5 black except diffuse white tip on inner web, and r6 also has slightly more extensive dark than adult ♀. Both sexes differ from ads in having retained juvenile primaries and tertials browner and less fresh with narrower, less sharply defined and less pure white tips; tail-feathers obviously pointed. **JUVENILE** Soft fluffy body feathering is generally rather sandy or sandy-brown, with few dark feather centres, very little pink visible on closed wing, and bill is dark horn-yellow becoming brownish at tip.

### *R. s. alienus*

Sexes generally less strongly differentiated than in *R. s. sanguineus* but otherwise they seem to have very similar moult and ageing characteristics. **SPRING Worn.** **Adult** ♂ Wear increases contrast of black cap, whitish tips to remiges virtually wear off, and pale areas of face become slightly more pronounced (often with slight pinkish hue to cheeks), but much more limited seasonal variation than in *R. s. sanguineus*. Like latter, pink-red basal areas to wings and tail more exposed and bill changes from greyish to dull warm yellow when breeding. In the hand, unlike *R. s. sanguineus*, r5 is mostly dark/black except for whitish tip, and thus lacks dark subterminal field to inner web, whilst r6 is also almost completely dark/black, including the outer web, except for an usually sharp wedge on the inner web. **Adult** ♀ Very similar to ♂ (many probably impossible to sex in the field), but overall duller with paler and less solid crown and much-reduced greyish nape; also white throat patch slightly less sharply defined and cheeks mostly lack pinkish; underparts virtually identical to ♂, but remiges (especially central part) and primary-coverts more narrowly fringed paler pink. Tail pattern recalls ♂ but pale tips rather conspicuously reduced and these and wedge on inner web of r6 diffuse and sullied pale buff-brown. Bill generally duller with less yellow tinge. **First-summer** Very like respective adults and best differentiated by retained juvenile wing- and tail-feathers, and moult limits as in first-winter. Extent of subterminal black areas in r5–6 also as first-winter. Due to reduced dark cap and pink in wing, both sexes are less strongly patterned than adults and are less easily sexed, whilst especially some first-summer ♂♂

can approach adult ♀ in overall plumage. **AUTUMN Fresh.** **Adult** ♂ Black crown patch narrowly fringed cinnamon-buff and duller, pinkish facial areas reduced or lacking, upperparts slightly more buffish, and brown-buff breast and flanks more obviously tipped whitish. **Adult** ♀ Much as spring. Both sexes differ from first-winters in being evenly fresh with broader, more solid and whiter primary tips. However, in comparison with adult *sanguineus* the primary tips are narrower and less pure white (whitish-cream with a pale buff-brown tinge). **First-winter** ♂ Like fresh adult ♂ but overall plumage strongly approaches ♀ (especially adult), thus sexual dimorphism obscured. However, unlike most first-winter ♀♀, crown darker and more clearly defined, and some have a hint of grey on nape (lacking in first-winter ♀), whilst pink edges of wing substantially broader and brighter. Retained juv greater coverts have brown inner webs and brown-buff on most of outer web; the retained primary-coverts are mostly blackish brown except for a thin pinkish edge to outer web. Tail (retained juvenile feathers) has more extensive dark areas than adult ♂ and pattern approaches adult ♀ with even more diffuse and buffier tips, and reduced (or virtually lacks) pale wedge on inner web of r6. **First-winter** ♀ Much like first-winter ♂ but paler with strongly reduced dark in cap, no grey on nape, reduced pink in wing and has fringes to greater coverts mainly buff; tail pattern variable, as in first-winter ♂ or with even more obscure pale areas. Both sexes differ from adults in having retained juvenile primaries and tertials, which are browner basally, less fresh and have considerably more diffuse and buffier tips; tail-feathers distinctly pointed. **JUVENILE** Not examined but probably close to *R. s. sanguineus*.

### Discussion

Allopatric taxa, as noted by Helbig *et al.* (2002), always present particularly problematic cases when endeavouring to ascertain whether they such forms should be regarded specifically, for as these authors succinctly state: 'Assignment of species rank in such cases will necessarily be based on hypothesis, rather than on proven facts.' In the present case, as discussed elsewhere (e.g. Kirwan & Gregory 2005), the two taxa concerned may well prove to be the sole constituents of the genus *Rhodopechys* and they are clearly rather close in general morphology, ecol-

ogy and habits. Nonetheless, they are also easily diagnosable in virtually all plumages, with only first-summer males liable to any confusion at their only point of contact, the museum cabinet! In addition, females of the two forms, especially, clearly separate using a multivariate statistical analysis of mensural data (see Table 1, and Figs. 1–2), and the degree of segregation is quite marked in comparison to that exhibited by what have traditionally been viewed as closely related taxa, although Groth (1998) found *Rhodopechys sensu lato* to be polyphyletic. In sum, again bearing in mind the guidelines of Helbig *et al.* (2002) it seems that the two *Rhodopechys* demand recognition under any of the pattern-defined species concepts currently operating (see Sluys & Hazevoet 1999) and have certainly achieved allospecies status, but whether they have achieved full species rank under the modern definition of the Biological Species Concept must probably await the results of molecular analysis. In contrast, the two taxa discussed here would surely be recognised as species under the framework of the Metapopulation Lineage Concept of species (or General Species Concept), application of which it was argued recently by de Queiroz (2005) not only provides a means of unifying how modern-day biologists diagnose 'species,' but also returns more closely to Mayr's original conceptualisation of what constitutes a species, rather than merely focusing on the attribute of reproductive isolation.

Like several other taxa recently assigned allospecies or full species status, the distributions of the two finches discussed here accord rather well with an increasingly recognised biogeographical phenomenon under which North Africa is viewed as something of a refugium for endemic taxa. In several cases, e.g. the two Desert Warblers *Sylvia deserti* and *S. nana* (Shirihai *et al.* 2001), the closest extant relative is restricted to Central Asia and the Middle East. As already noted for the genus *Sylvia*, but probably for many other additional groups, quite plausibly even the genus *Rhodopechys*, the long drought known as the Messinian Crisis, which peaked some 5.5–8.5 MYA and which led to the entire Irano-Turanian region becoming extremely dry and to the Mediterranean shrinking in size (Suc 1984, Tchernov 1988), may have played an important role in this process. Again, to some extent the answers to such enigmas lie in genetics.

Nonetheless, we believe, as this paper demonstrates, that the museum skin continues to hold a high value in avian taxonomic studies and, like Collar (2004), we bemoan the current trend to seemingly regard molecular tools as the only means to adequately progress such research.

### Acknowledgements

We are grateful to the following for various kindnesses associated with the preparation of this manuscript: Vasil Ananian, Göran Ekström, Andrew Grieve, Giuseppe Micali, René Pop, Sandy Rae, and Mark Adams, Alison Harding, Robert Prýs-Jones, Michael Walters and Effie Warr (of The Natural History Museum, Tring). Magnus Robb assisted with the vocal analysis. Ron Demey and Françoise Dowsett-Lemaire prepared the French summary. Kees Roselaar refereed the manuscript. GMK's field studies in Turkey (and elsewhere) were abetted by a number of additional people and organisations that are fully credited in Kirwan & Konrad (1995) and Kirwan *et al.* (2000). GMK is grateful to Roy & Moira Hargreaves, and John & Effie Warr for accommodation during his visits to Tring.

### References

- Clement, P., Harris, A. & Davis, J. 1993. *Finches and Sparrows: An Identification Guide*. London, UK: Christopher Helm.
- Collar, N. J. 2004. Species limits in some Indonesian thrushes. *Forktail* 20: 71–87.
- Cramp, S. & Perrins, C. M. (eds.) 1994. *The Birds of the Western Palearctic*. Vol. 8. Oxford: Oxford University Press.
- David, N. & Gosselin, M. 2002. The grammatical gender of avian genera. *Bull. Br. Ornithol. Club* 122: 257–282.
- Desfayes, M. 1969. Remarques sur les affinités des Fringillidés des genres *Rhodopechys* et *Callacanthis*. *Oiseau & R.F.O.* 39: 21–27.
- Fry, C. H. & Keith, S. K. (eds.) 2004. *The Birds of Africa*. Vol. 7. London, UK: Academic Press.
- Groth, J. G. 1998. Poster abstracts 118: Molecular phylogeny of the cardueline finches and Hawaiian honeycreepers. *Ostrich* 69: 401.
- Helbig, A. J., Knox, A. G., Parkin, D. T., Sangster, G. & Collinson, M. 2002. Guidelines for assigning species rank. *Ibis* 114: 518–525.
- Isenmann, P. & Moali, A. 2000. *Oiseaux d'Algérie*. Paris: Société d'Études Ornithologiques de France.
- Kirwan, G. M., Bechtolsheim, M. & Willig, S. 2000. Distribution of Mongolian Finch in Turkey. *Dutch Birding* 22: 149–150.



- Kirwan, G. M. & Gregory, S. M. S. 2005. A new genus for the Mongolian Finch *Bucanetes mongolicus* (Swinhoe, 1870). *Bull. Br. Ornithol. Club* 125: 68–80.
- Kirwan, G. & Konrad, V. 1995. Little known Western Palearctic birds: Mongolian Trumpeter Finch. *Birding World* 8: 139–144.
- Niethammer, G. 1966. Über die Kehltaschen des Rotflügelgimpels, *Rhodopechys sanguinea*. *J. Orn.* 107: 278–282.
- de Queiroz, K. 2005. Colloquium: Ernst Mayr and the modern concept of species. *Proc. Natl. Acad. Sci. USA* 102 suppl. 1: 6600–6607.
- Roselaar, C. S. (1995) *Songbirds of Turkey: An Atlas of Biodiversity of Turkish Passerine Birds*. Robertsbridge: Pica Press.
- Shirihai, H., Gargallo, G. & Helbig, A. J. 2001. *Sylvia Warblers: Identification, Taxonomy and Phylogeny of the Genus Sylvia*. London, UK: Christopher Helm.
- Shirihai, H. & Svensson, L. in prep. *Photographic Handbook to the Birds of the Western Palearctic*. London, UK: Christopher Helm.
- Sluys, R. & Hazevoet, C. J. (1999) Pluralism in species concepts: dividing nature at its diverse joints. *Species Diversity* 4: 243–256.
- Suc, J. P. 1984. Origin and evolution of the Mediterranean vegetation and climate in Europe. *Nature* 307: 429–432.
- Svensson, L. 1992. *Identification Guide to European Passerines*. Stockholm: privately published.
- Tchernov, E. 1988. The biogeographical history of the southern Levant. In Yom-Tov, Y. & Tchernov, E. (eds.) *The Zoogeography of Israel*. The Hague: Junk Publishers.
- Vaurie, C. 1949. Notes on some Asiatic finches. *Amer. Mus. Novit.* 1424: 1–63.
- Voous, K. H. 1977. *List of Recent Holarctic Bird Species*. London, UK: British Ornithologists' Union.
- Whitaker, J. I. S. 1897. [Descriptions of two new species from Morocco.] *Bull. Br. Ornithol. Club* 7: 17–18.
- <sup>a</sup> 74 Waddington Street, Norwich NR2 4JS, UK. E-mail: [biatas@bol.com.br](mailto:biatas@bol.com.br)
- <sup>b</sup> c/o The British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, UK.
- <sup>c</sup> Duinlustparkweg 98, 2082 EG Santpoort-Zuid, Netherlands.
- <sup>d</sup> Ausserdorfstraße 6, 8052 Zurich, Switzerland.

Received 31 March 2006; revision accepted 1 June 2006

# www.birdquest.co.uk

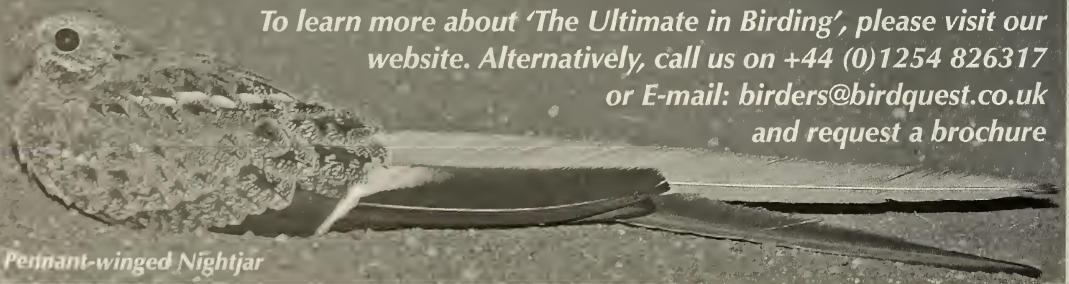
## Birdquest – the natural choice in Africa with unrivalled experience, small group sizes and remarkable leaders!



Morocco • Egypt • Gambia • Senegal • Ivory Coast • Cameroon • Gabon  
São Tomé & Príncipe • Ethiopia • Kenya • Uganda • Tanzania • Rwanda • Malawi  
Zambia • Angola • Namibia • Botswana • Zimbabwe • South Africa • Madagascar

All included in our extensive programme of more than 150 tours worldwide!

To learn more about 'The Ultimate in Birding', please visit our  
website. Alternatively, call us on +44 (0)1254 826317  
or E-mail: [birders@birdquest.co.uk](mailto:birders@birdquest.co.uk)  
and request a brochure



Penant-winged Nighthjar